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The Psychophysics of the Size-weight Illusion

IV. The Relation to Secondary Suggestibility

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Abstract. - Interindividual differences in sensibility to the size-weight illusion were related to secondary suggestibility as measured by progressive lines. No relation was found. It had been theorized that presentation order effects were a case of secondary suggestibility, but no relation was found. Finally, knowledge of the true weight and of the SWI of the stimuli used restricted the estimation range, but the effect was unrelated to secondary suggestibility.

In previous psychophysical studies, one of the present authors (L.H.) has investigated the effect of stimulus presentation order on the responses (Holmberg, 1964; Holmberg, Küller, & Tidblom, 1966; Fries & Holmberg, 1967). Sometimes a general presentation order effect has been established, sometimes significance has not been reached because of great individual differences. We wondered if those differences were due to random variation or to individual characteristics in the subjects. The effect has been explained in terms of Helson's adaptation level theory (Helson, 1964). Since all stimuli, previous as well as present, contribute to the constitution of the adaptation level (AL), it was possible that the individual differences mentioned above were related to the fluctuations of this AL. We theorized that a flexible AL, i.e., one that is easily affected by new stimulation, might be a sign of high perceptual (secondary) suggestibility in the subject, whereas a more rigid unaffected AL might correspond to low suggestibility.

We also speculated over the individual differences in the susceptibility to the size-weight illusion (SWI) studied in some earlier investigations (Fries & Holmberg, 1967; Fries & Holmberg, 1968; Holmberg, Hellsten, & Hector, 1968). This illusion seems to be present in all normal subjects above six years of age and is probably little influenced by experience, as is shown in the second of the studies cited above. However, since different subjects require different changes in volume to make differential weight responses we theorized that this is also a case of secondary suggestibility.

Thus, in a psychophysical experiment on SWI we can study two effects, the presentation effect and the illusion effect, both of which might be

related to suggestibility. This can be measured by Binet's experiment with progressive lines, also employed by Stukát (1958).

In this investigation Stukát found a correlation of 0.07 between progressive lines and SWI, but since his subjects were children and his SWI measure differs from ours, we need not nessecarily expect zero correlation.

Finally, we wondered what effect the knowledge that the weights are all equal might have on the magnitude of the heaviness estimations in the SWI experiment. Will the subject accept heaviness perceptions which are contradictory to his knowledge, or will his responses be governed by cognitive factors? Or will even his perception be affected by the knowledge? We doubt that the latter is the case, since we ourselves have never been able to supress the illusion in spite of having checked the real weight on a scale several times. Besides, the two alternatives cannot be separated, since they have the same consequences with respect to the responses. The most important question is, however, if the change in response is related to suggestibility.

Problem

1. To study the relation of SWI to secondary suggestibility, as measured by responses to progressive lines.
2. To study the relation of the presentation order effect to secondary suggestibility.
3. To study the influence of knowledge of the true weight on the magnitude of the heaviness estimations in the SWI experiment and its possible relation to suggestibility.

Method

I. Experimental design.

From a larger group of subjects who participated in an experiment on secondary suggestibility (progressive lines), two extreme groups were chosen (high vs low suggestibility).

Each group participated in an SWI experiment; in addition, four subjects

from each group were assigned to an experimental group and the rest to a control group. Those latter groups differed as to knowledge of the true weight in the second of two series of heaviness estimations.

The SWI experiment took place three weeks after the suggestibility experiment. At this occasion all fourteen subjects started with an ascending and descending series. In the second series, a randomized order was used, since a repetition of the ascending/descending order probably would have led the subjects to remember their previous response sequency. During the interval between the two series the experimental group weighed the prisms on a sensible scale, noted their weight and were told about the SWI. The control group continued with the second series of lifting.

II. Experimental arrangement.

In the suggestibility experiment eighteen black lines were put on slides. The lines of the first nine slides were all progressively longer, but the lines on slides 9-18 were all of the same length. This part of the experiment was performed in a large lecture hall. The subjects were seated in the four last rows, about 15 meters from the projection screen, the room being illuminated with a weak artificial light. Each subject had a protocol with 18 vertical lines drawn. On the first line a short vertical bar was drawn, indicating the length corresponding to the line on the first slide.

In the SWI experiment seven cylindrical prisms were used as stimuli. They all weighed 500 grams, and their volume ranged from 200 to 800 cm^3 in steps of 100. The ratio between height and diameter was 2:1. The cylinder in the middle of the series (volume 500 cm^3) served as a standard and was not used as a comparison. A screen with an opening (40 x 30 cm) prevented the subject from seeing the prisms not in use.

III. Procedure.

The suggestibility experiment was a group experiment. At one sitting 23 subjects participated, at a second the remaining 22. The slides were projected one by one on the screen, and the task of the subjects was to mark the length of the projected line in the protocol by means of a vertical

bar on the horisontal line which corresponded to the one projected.

In the SWI experiment the subject was seated before the screen. The standard together with one comparison at a time was presented in the opening side by side. The task of the subject was to lift first the standard and then the comparison till their lower extremities reached a red mark on the screen. After lifting both, the comparison was to be graded for its heaviness in relation to the standard, which was arbitrarily assigned 100 points.

After lifting the prisms in ascending and descending order, the control group immediately proceeded with another series, whereas the experimental group weighed the prisms on the scale as mentioned above. After this, they continued with the last series.

IV. Subjects.

In the suggestibility experiment 45 female Teachers College students, aged 20-26 years, served as subjects. All subjects volunteered and were paid for their participation.

Results

1. The protocols from the suggestibility experiment were scored in two ways. First, we counted the total number of times that each line from No. 10-18 was marked as longer than the preceeding line. Second, we counted the number of consecutive increases following line no 9. The latter measure gave a somewhat more skewed distribution than the former. Both measures turned out to give the same result with respect to extreme suggestibility groups. The distributions are as follows:

	Total number of increases	Number of consecutive increases
Scale values:	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Frequencies:	2 1 6 16 5 5 2 3 3 2	8 11 10 8 2 1 0 1 2 2

2. The SWI effect can be measured in several ways. We need a measure for the tendency to give higher weight estimations to smaller volumes and lower weight estimations to larger volumes. One such measure is the

sum of estimations for the three smallest prisms minus the corresponding sum for the three largest prisms. According to our idea, this measure should be related to the measure of suggestibility. However, no such relation was found in our data (fourfold contingency tables).

3. No relationship in terms of fourfold tables was found between suggestibility and presentation order.

4. The last question to be answered is whether the SWI effect is less if the subject is aware that the real weight of the prisms is the same. Fig. 1 indicates that it is so, and an analysis of variance shows that the effect (interaction SxVxK) is significant in spite of the fact that it is comparatively small.

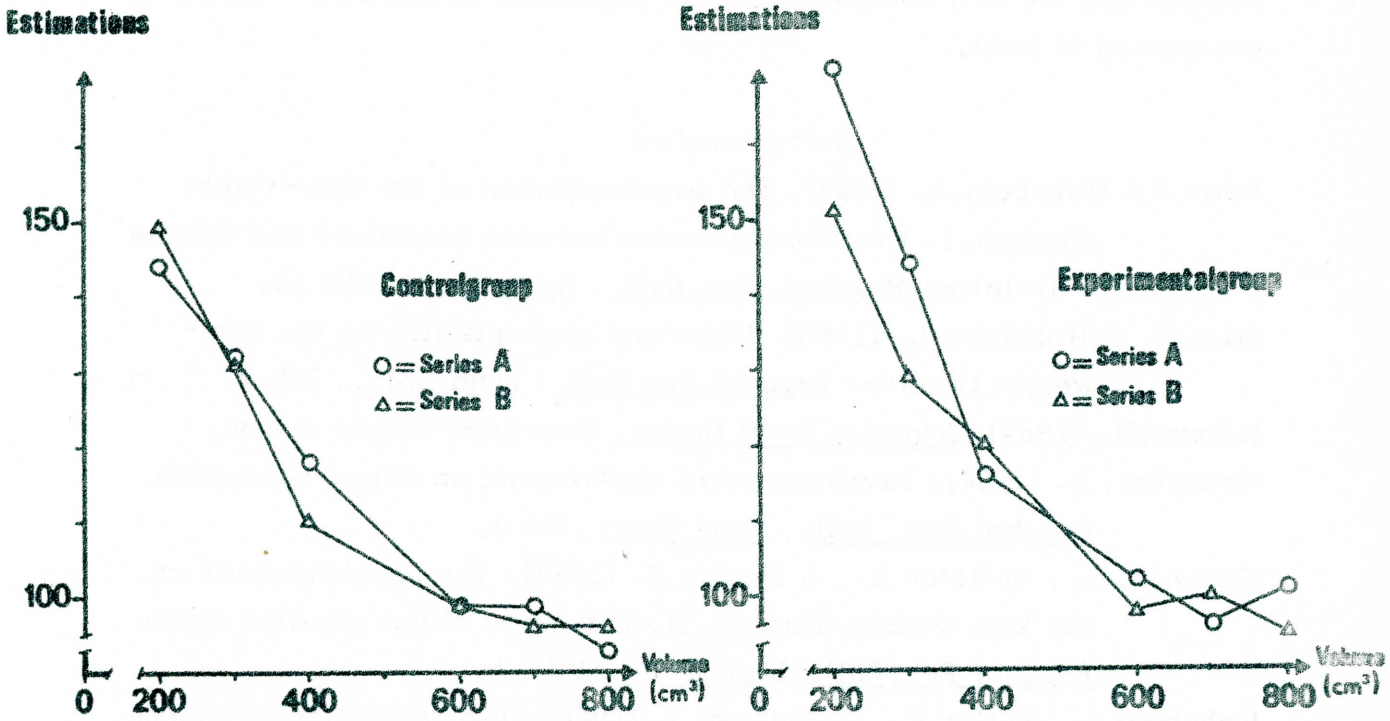

Fig. 1. Heaviness estimations as a function of volume. Although the total range is greater for the experimental group, the range for Series B is smaller than that for Series A. In the control group the range is the same for both series. In the analysis of variance this corresponds to a significant SxVxK interaction. The greater range in the experimental group, which corresponds to the KxV interaction, is not significant.

When relating the knowledge effect to suggestibility we used the difference between the two series as a measure of the knowledge effect. This could,of course,be done only in the experimental group. No relationship was found.

Conclusion

No relationship with progressive lines has been found in the SWI experiment. Provided the progressive lines experiment really measured secondary suggestibility, individual variation in sensibility to the SWI effect or to the presentation order cannot be explained in terms of perceptual suggestibility. What is shown is that knowledge of the SWI somewhat damps the responses;Whether this phenomenon can be interpeted as a change in the perception of heaviness or as a restriction in quantification on the part of the subjects has not been established. A resolution of this problem may lie in a comparison of the magnitude estimation method with the method of limit.

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Table I. Analysis of variance of heaviness estimations.

Source of variation	df	Sum of squares	F	P
Between subjects	13	72835.1		
Knowledge of SWI (K)	1	3483.4	K/E_b= .60	>.05
$Error_b$ (E_b)	12	69351.7		
Within subjects	154	448366.7		
Series (S)	1	2002.4	S/E_1= 2.15	>.05
Volume (V)	5	313200.0	V/E_2=43.69	<.0005
SxV	5	2617.3	SxV/E_3= 1.37	>.05
SxK	1	1161.2	SxK/E_1= 1.25	>.05
VxK	5	3342.3	VxK/E_2= .47	>.05
SxVxK	5	5913.6	$SxVxK/E_3$= 3.10	.01<P<.025
$Error_{1w}$ (E_1)	12	11178.1		
$Error_{2w}$ (E_2)	60	86024.4		
$Error_{3w}$ (E_3)	60	22927.4		
Total	167	521201.8		

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